

# Human Factors in Training

Human Research Program - Space Human Factors & Habitability  
Space Human Factors Engineering Project  
Immanuel Barshi<sup>1</sup> (PI), Vicky Byrne<sup>2</sup>, Lucia Arsintescu<sup>3</sup>, Erin Connell<sup>2</sup>, Anikó Sándor<sup>2</sup>  
<sup>1</sup>NASA Ames Research Center (ARC)  
<sup>2</sup>NASA JSC, Lockheed Martin, <sup>3</sup>NASA ARC, San Jose State University Foundation



## TRAINING DIRECTED RESEARCH PROJECT OVERVIEW

Future space missions will be significantly longer than current shuttle missions and new systems will be more complex than current systems. Increasing communication delays between crews and Earth-based support means that astronauts need to be prepared to handle the unexpected on their own. As crews become more autonomous, their potential span of control and required expertise must grow to match their autonomy. It is not possible to train for every eventuality ahead of time on the ground, or to maintain trained skills across long intervals of disuse. To adequately prepare NASA personnel for these challenges, new training approaches, methodologies, and tools are required. This research project aims at developing these training capabilities. By researching established training principles, examining future needs, and by using current practices in space flight training as test beds, both in Flight Controller and Crew Medical domains, this research project is mitigating program risks and generating templates and requirements to meet future training needs. Training efforts in Fiscal Year 08 (FY08) strongly focused on crew medical training, but also began exploring how Space Flight Resource Management training for Mission Operations Directorate (MOD) Flight Controllers could be integrated with systems training for optimal Mission Control Center (MCC) operations.

The Training Task addresses Program risks that lie at the intersection of the following three risks identified by the Project:

- Risk associated with poor task design
- Risk of error due to inadequate information
- Risk associated with reduced safety and efficiency due to poor human factors design

## Flight Controller Training

Based on the understanding of MOD needs, constraints, and current practices, a conceptual framework for **Operationally Oriented Training** was developed.

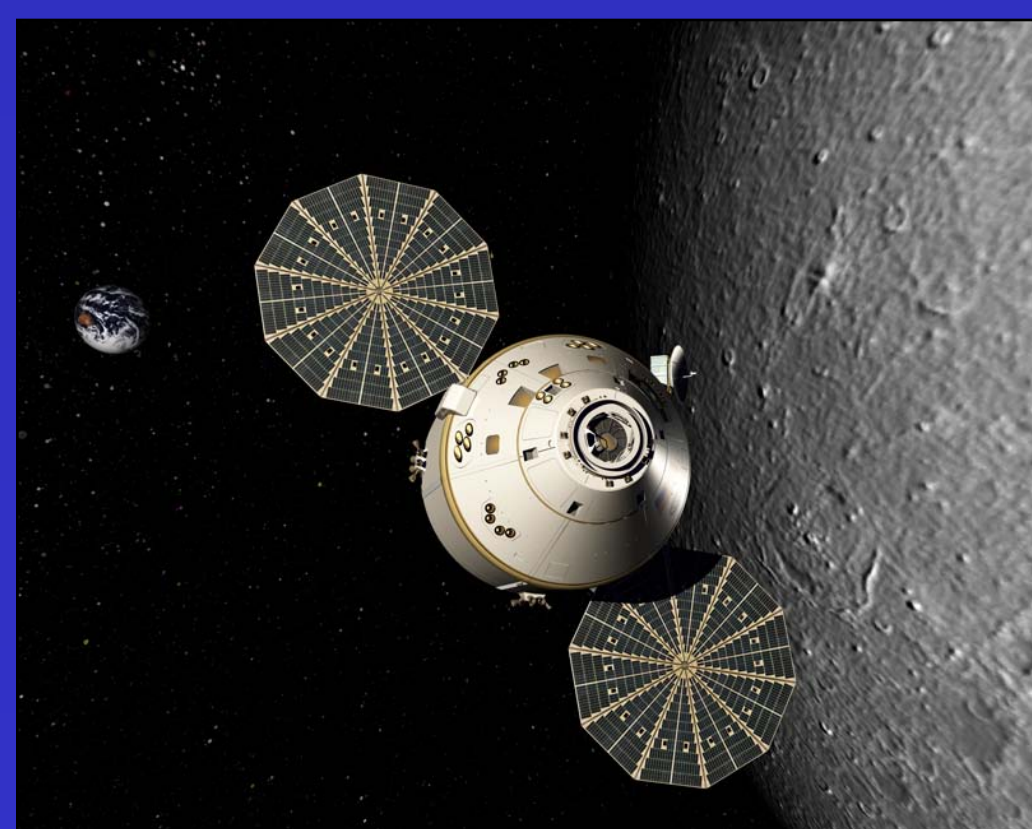
This framework integrates research on adult learning principles, lessons learned in analog domains, and the results of multiple extensive discussions with MOD training and operations personnel.

To improve performance on Space Flight Resource Management (SFRM) skills, to enable early recognition of SFRM challenges, and to increase the overall effectiveness of Flight Controllers' training, our framework introduces SFRM early in the training flow, to integrate SFRM skills with the technical skills, and to provide continuous explicit guidance and feedback on SFRM performance throughout training and operations.



### Trade Study of Analogue Environments to Conduct Studies for Training

To understand crew performance under the expected conditions of future space flight missions, analogue environments must be used. To assess the value of such environments for evaluating training methods, a comparative study of space-analogue environments was conducted.



### SFRM Generic Training Framework Concept Prototype

The report describes a game which is a generic training tool prototype for multi-agent interactions, and as such can be used to develop the foundational Space Flight Resource Management (SFRM) skills needed by Flight Controllers for effective team work in MCC operations. The game teaches how to identify early signs of increased workload and stress in one's self and in others, and how to anticipate information needs including pushing information to other team members before they have to request it, and pulling information when necessary. Furthermore, the game teaches and reinforces critical debriefing skills.

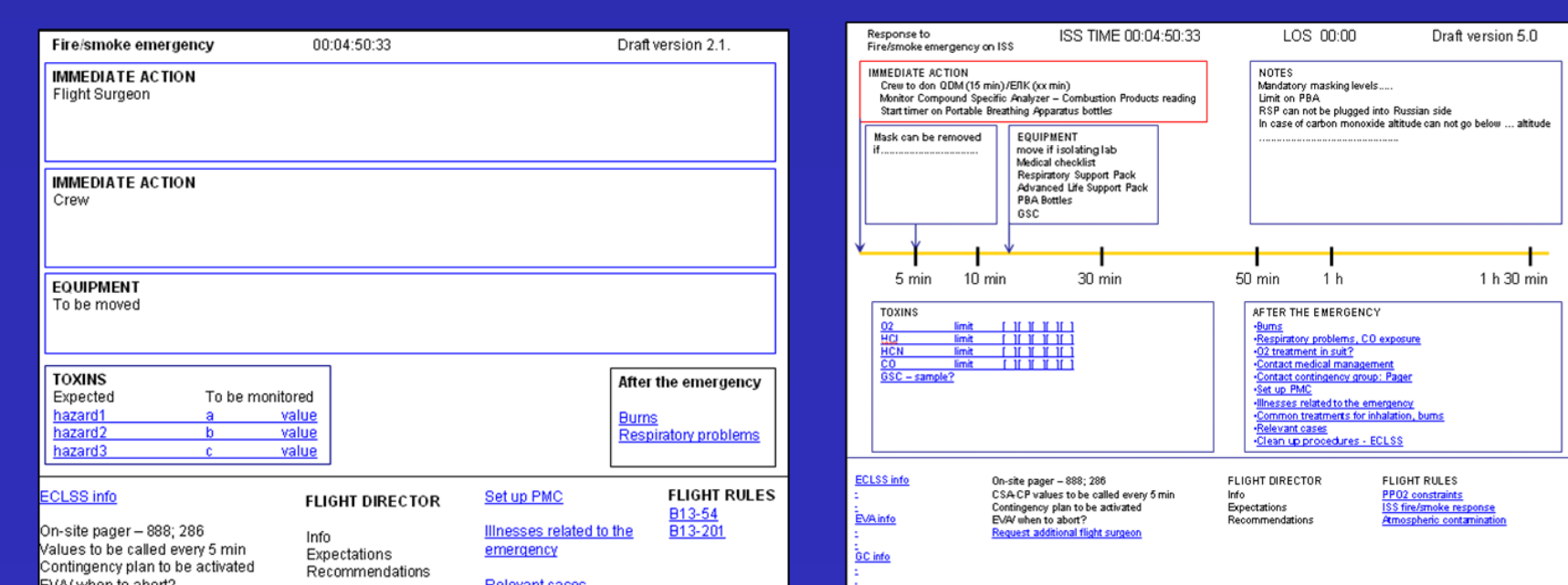
## Medical Training

### Constellation Medical Training Needs Analysis

In FY08, a Constellation medical training needs analysis was performed that examined the most current Constellation Crew Exploration Vehicle (CEV) Medical Operations group's Concept of Operations and identified expected space medical training needs according to the mission type. This report highlighted areas for further research. In addition to this report, five individual interviews were conducted with ISS long duration crewmembers regarding space medical training. From both of these activities, specific project related research has been developed and will continue into FY09 and beyond.

### Demonstration of JIT Training Technique

This product consisted of an investigation and demonstration of just-in-time training techniques. Three components were delivered as a JIT training technique package: a general overview of JIT training; a survey of medical techniques that claim to be JIT training tools and their features and components; and a paper-based concept prototype for a Flight Surgeon's real-time decision aid/JIT training concept for ISS emergencies.



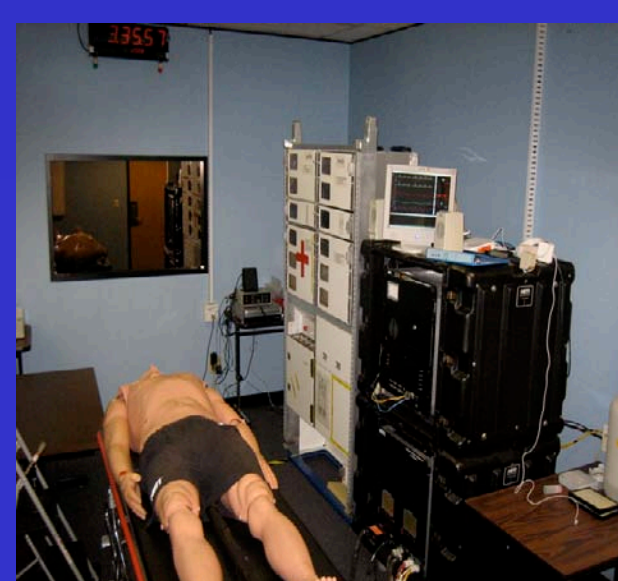
Flight Surgeon Decision Aid  
Version 1 – Layout Sketch Draft

Flight Surgeon Decision Aid  
Version 5 – More Detailed Draft

The Flight Surgeon's decision aid prototype concept stems from discussions with the Space Medical Training Stakeholder. Currently, when a Flight Surgeon is sitting on console supporting a mission, references in many locations require him/her to look at multiple resources to respond to any ISS emergency. Flight Surgeons need efficient console support (real-time decision aid/JIT training). The prototype tool could provide the Flight Surgeon with a quick reference to each emergency.

### Exploratory Evaluation of JIT Training Tools for an Emergency Procedure

A preliminary evaluation of JIT medical training on two display devices (a head-up display and a handheld PDA) was conducted in the last quarter of FY08. Baseline measurements were gathered (e.g. types of errors, scenario completion times) for planning an integrated evaluation, and assist with further development of prototype JIT training tools. This exploratory research provides a better understanding of performance times and types of errors associated with each media device, and will lead to an integrated evaluation using a prototype software tool in the first quarter of FY09.

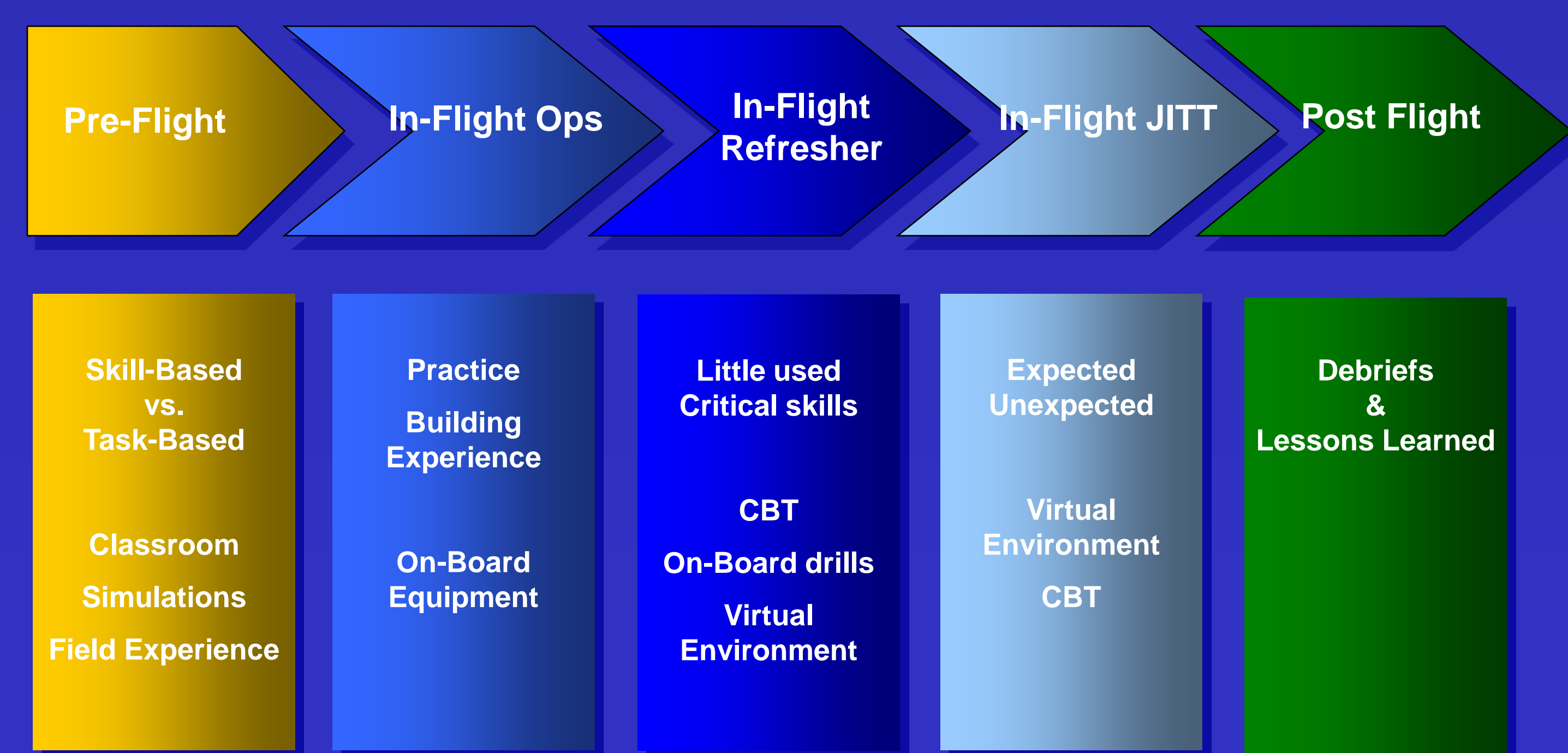


POC: Dr. Immanuel Barshi, ARC/TH Email: [Immanuel.Barshi@nasa.gov](mailto:Immanuel.Barshi@nasa.gov) Phone: 650-604-3921

## FY08 Deliverables



## Future Research Direction The Training Continuum



### Some Research Questions:

- What are the basic and generalizable skills underlying different tasks?
- What is the optimal distribution of topics across training opportunities?
- What is the optimal delivery method and media for a given training topic?
- How do we assess proficiency?

### Stakeholders:

Robert Banfield, *Chief, Expedition Vehicle Division, JSC/DI*  
Dr. Joseph Schmid, *Lead, Space Medicine Training, Medical Operations, JCS/SD*